The scientific goal of the project is to develop new nanocomposite optical fibers co-doped with quantum dots (QDs) and rare earth ions (RE), characterized by broadband emission in the near-infrared range (NIR). The project is based on the hypothesis that it is possible to achieve ultra-broadband emission (1.0-1.7 μm) in a single-core optical fiber through energy transfer between quantum dots and rare earth ions, and the superposition of their emission bands. To verify this hypothesis, an innovative approach has been proposed, involving the controlled growth of quantum dots in optical fibers using a one-step method. This new method involves using an additional furnace on the fiber drawing tower to control the growth process of quantum dots in the fiber core during the drawing process. This process will be compared with the currently used heat treatment method by annealing in a furnace, CO2 laser, or femtosecond laser.

Broadband emission in the near-infrared is crucial for many fields such as telecommunications, medicine (OCT), metrology, and gas sensors. In particular, in telecommunications, there is a continuous need to increase the capacity of WDM systems, which drives the development of optical amplifiers.

The project comprises two work packages:

1. Work Package 1 (WP1): Synthesis and analysis of the luminescent and structural properties of QDs-doped and co-doped glasses with QDs and rare earth ions for optical fiber applications. The possibility of obtaining quantum dots in glass using various methods, such as glass annealing and CO2 or femtosecond laser processing, will be investigated.

2. Work Package 2 (WP2): Fabrication of optical fibers and characterization of their luminescent and propagation properties. The fibers will be examined for quantum dot growth in the annealing process in a furnace or using lasers (CO2/FS), and using the proposed new one-step quantum dot production method during the fiber drawing process. Spectroscopic and structural measurements of fabricated fibers will be carried out to compare proposed methods.

The project team, including researchers from Bialystok University of Technology, AGH University of Science and Technology in Krakow, and the Institute of Ceramics and Glass in Madrid, will conduct spectroscopic and structural analysis of the produced glasses and optical fibers. Preliminary experiments conducted by the project leader have shown the possibility of obtaining a broadband luminescence spectrum in glass doped with PbS quantum dots and Er^{3+} ions. The project aims to develop new nanocomposite materials co-doped with quantum dots and rare earth ions for use in optical fiber technology and photonics. The results will contribute to the advancement of the disciplines of automation, electronics, electrical engineering, and space technologies, particularly in the production of new optical fiber sources operating in the near-infrared range.